

# Exclusive Vector Meson Production in Relativistic Heavy Ion Collisions

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We calculate the rates for reactions such as  $Au + Au \rightarrow Au + Au + V$ , where  $V$  is a vector meson such as a  $\rho$ ,  $\omega$ ,  $\phi$  or  $J/\psi$ [1]. The production rates turn out to be extremely high, up to 690 Hz for the  $\rho$  with iodine beams at RHIC, and up to 240kHz with calcium beams at LHC. These reactions will be an important part of the physics program at RHIC and LHC, and qualify these colliders as vector meson factories[2].

The reactions occur when the electromagnetic field of one nucleus interacts coherently with the other nucleus, via a mediating Pomeron or meson. At RHIC and LHC, the photon is energetic enough so that the momentum transfers to the nuclei are small enough that both couplings are coherent, so the amplitudes add coherently, and the nuclei remain intact, or nearly so.

The photon flux is given by the standard Weizsäcker-Williams approach. The cross sections for photonuclear interactions are scaled from photon-proton data from HERA and lower energy fixed target experiments. The scaling is done with a Glauber calculation. The photon flux times  $\gamma A$  cross section is integrated over impact parameter, subject to the requirement that no hadronic interactions occur; the latter is determined with Woods-Saxon profiles for the two nuclei. The target nuclear form factor is given by the convolution of a hard sphere plus Yukawa potential, which is very close to a Woods-Saxon potential, with the advantage that the Fourier transform is fully analytic.

Some production rates are given in Table 1. Figure 1 shows  $d\sigma/dy$  for  $\rho$  production. Photons from each direction produce a peak in their incident hemisphere.

## References

[1] S. Klein and J. Nystrand, “Exclusive Vec-

Accelerator	$\rho$	$\phi$	$J/\psi$
RHIC-Au	120	8	0.06
RHIC-I	620	39	0.3
LHC-Ca	230,000	15,000	780

Table 1: Production rates, per second, for vector mesons for different beams at RHIC and LHC. All rates are based on the accelerator design luminosity.

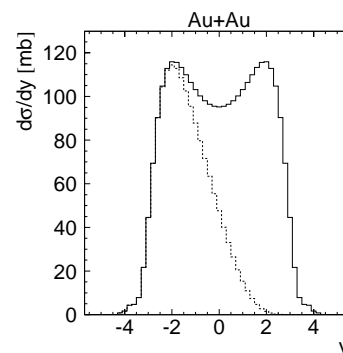


Figure 1:  $d\sigma/dy$  distribution for exclusive  $\rho$  production with gold beams at RHIC. The dotted line is for photons 'from the left', and the solid line is the total.

tor Meson Production in Relativistic Heavy Ion Collisions,” LBNL-42768, preprint hep-ph/9902259, submitted to Phys. Rev. C.

[2] J. Nystrand and S. Klein, “Two-Photon Physics in Nucleus-Nucleus Collisions”, LBNL-42524, preprint hep-ph/9811007, Nov., 1998, in Proc. Workshop on Photon Interactions and the Photon Structure, Lund, Sweden, Sept., 1998.